

In the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A spin-valve magnetoresistive sensor comprising, on a substrate, an antiferromagnetic layer; a pinned magnetic layer formed in contact with said antiferromagnetic layer and having a magnetization direction made stationary under an exchange anisotropic magnetic field generated by interaction with said antiferromagnetic layer; a free magnetic layer divided into a first free magnetic layer disposed farther away from the pinned magnetic layer and a second free magnetic layer disposed closer to the pinned magnetic layer; a non-magnetic intermediate layer interposed between the first free magnetic layer and the second free magnetic layer, and the first magnetic layer having recesses formed therein, the recesses formed only in the first free magnetic layer; a non-magnetic electrically conductive layer formed between said free magnetic layer and said pinned magnetic layer; soft magnetic layers that are arranged on said first free magnetic layer having a spacing between said soft magnetic layers corresponding to a track width defined at a level at which said soft magnetic layers fill the recesses in the first free magnetic layer; bias layers formed on said soft magnetic layers to uniformly arrange a magnetization direction of said free magnetic layer in a direction crossing the magnetization direction of said pinned magnetic layer; and electrically conductive layers formed on the bias layers to apply a detection electric current to said free magnetic layer, wherein a thickness of said soft magnetic layers exceeds a depth of the recesses, and said antiferromagnetic layer and said bias layer each comprising an alloy containing Mn and at least one element selected from a group consisting of Pt, Pd, Rh, Ru, Ir, Os, Au, Ag, Cr, Ni, Ne, Ar, Xe, and Kr, and wherein said first and second free magnetic layers are held a ferrimagnetic state in which the first and second layers are magnetized in directions 180° different from each other.

2. (Currently Amended) A spin-valve magnetoresistive sensor according to Claim 1, wherein ~~at least one of said pinned magnetic layer and said free magnetic layer~~ is divided into two layers with a non-magnetic intermediate layer interposed between the two layers, and the divided two layers are held in a ferrimagnetic state in which the divided two layers are magnetized in directions 180° different from each other.

3. (Previously Presented) A spin-valve magnetoresistive sensor according to Claim 1, wherein said antiferromagnetic layer comprises an alloy having the following composition formula: $X_m\text{Mn}_{100-m}$ where X is at least one element selected from a group consisting of Pt, Pd, Rh, Ru, Ir and Os, and a composition ratio m satisfies $48 \text{ atom } \% \leq m \leq 60 \text{ atom } \%$.

4. (Previously Presented) A spin-valve magnetoresistive sensor according to Claim 1, wherein said bias layer comprises an alloy having the following composition formula: $X_m\text{Mn}_{100-m}$ where X is at least one element selected from a group consisting of Pt, Pd, Rh, Ru, Ir and Os, and a composition ratio m satisfies $48 \text{ atom } \% \leq m \leq 60 \text{ atom } \%$.

5. (Previously Presented) A spin-valve magnetoresistive sensor according to Claim 1, wherein said antiferromagnetic layer comprises an alloy having the following composition formula: $\text{Pt}_m\text{Mn}_{100-m-n}\text{D}_n$ where D is at least one element selected from a group consisting of Pd, Rh, Ru, Ir and Os, and composition ratios m, n satisfy $48 \text{ atom } \% \leq m + n \leq 60 \text{ atom } \%$ and $0.2 \text{ atom } \% \leq n \leq 40 \text{ atom } \%$.

6. (Previously Presented) A spin-valve magnetoresistive sensor according to Claim 1, wherein said bias layer comprises an alloy having the following composition formula: $\text{Pt}_m\text{Mn}_{100-m-n}\text{D}_n$ where D is at least one element selected from a group consisting of Pd, Rh, Ru, Ir and Os, and composition ratios m, n satisfy $52 \text{ atom } \% \leq m + n \leq 60 \text{ atom } \%$ and $0.2 \text{ atom } \% \leq n \leq 40 \text{ atom } \%$.

7. (Previously Presented) A spin-valve magnetoresistive sensor according to Claim 1, wherein said soft magnetic layer comprises a NiFe alloy.

8. (Previously Presented) A spin-valve magnetoresistive sensor according to Claim 1, wherein recesses are formed in said free magnetic layer on both sides of an area corresponding to the track width, said soft magnetic layers are formed to fill said recesses and are directly joined to said free magnetic layer through bottom surfaces of said recesses, and said bias layers and said electrically conductive layers are successively formed on said soft magnetic layers.

9. (Previously Presented) A spin-valve magnetoresistive sensor according to Claim 1, wherein a magnetic film thickness of said first free magnetic layer is smaller than a magnetic film thickness of said second free magnetic layer.

10. (Withdrawn) A method of manufacturing a spin-valve type magnetoresistive sensor comprising:

forming an antiferromagnetic layer, a pinned magnetic layer, a non-magnetic electrically conductive layer, and a free magnetic layer successively on a substrate, thereby forming a first laminate;

heat-treating said first laminate at a first heat treatment temperature while applying a first magnetic field in a direction perpendicular to a direction of a track width, thereby generating an exchange anisotropic magnetic field in said antiferromagnetic layer to make magnetization of said pinned magnetic layer stationary;

forming soft magnetic layers on said first laminate while a spacing corresponding to the track width is left between said soft magnetic layers, forming bias layers on said soft magnetic layers, and forming electrically conductive layers on said bias layers for applying a detection electric current to said free magnetic layer, thereby forming a second laminate; and

heat-treating said second laminate at a second heat treatment temperature while applying a second magnetic field smaller than the exchange

anisotropic magnetic field of said antiferromagnetic layer in a direction of the track width, thereby imparting a bias magnetic field to said free magnetic layer in a direction crossing a magnetization direction of said pinned magnetic layer.

11. (Withdrawn) A method of manufacturing a spin-valve type magnetoresistive sensor according to Claim 10, wherein said antiferromagnetic layer and said bias layers are each made of an alloy containing at least one or more elements selected from among Pt, Pd, Rh, Ru, Ir, Os, Au, Ag, Cr, Ni, Ne, Ar, Xe and Kr, as well as Mn.

12. (Withdrawn) A method of manufacturing a spin-valve type magnetoresistive sensor according to Claim 10, wherein said first heat treatment temperature is in a range of 220°C - 270°C.

13. (Withdrawn) A method of manufacturing a spin-valve type magnetoresistive sensor according to Claim 10, wherein said second heat treatment temperature is in a range of 250°C - 270°C.

14. (Withdrawn) A method of manufacturing a spin-valve type magnetoresistive sensor according to Claim 10, wherein said second magnetic field is in a range of 10 - 600 Oe (800 - 48000 A/m).

15. (New) A spin-valve magnetoresistive sensor according to Claim 1, wherein a surface of the first free magnetic layer in which the recesses is contained is substantially free from contaminants.

16. (New) A spin-valve magnetoresistive sensor according to Claim 1, wherein the recesses in the first free magnetic layer are formed by removing a surface of the free magnetic layer.